

# Oral Health Status and Patterns of Dental Service Utilization of Adolescents in Lesotho, Southern Africa

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# Abstract

**Objectives:** To identify the unmet dental treatment needs and patterns of dental service utilization by adolescents in the Kingdom of Lesotho, Southern Africa, and characterize the best predictors for perceived oral health status and dental visits for these adolescents.

**Method:** A self-reported 40-item oral health survey was administered, and clinical oral examinations were conducted in public schools in Maseru from August 10 to August 25, 2016. Associations between psychosocial factors with oral health status and dental service utilization were evaluated using simple, bivariate and multivariate regressions.

**Results:** Five hundred and twenty-six survey responses and examinations were gathered. The mean age of participants was 16.4 years of age, with a range between 12 and 19 years of age. More than two thirds (68%; n=355) of participants were female. The majority reported their quality of life (84%) and general health to be good/excellent (81%). While 95% reported that oral health was very important, only 11% reported their personal dental health as excellent. Three percent reported having a regular family dentist, with the majority (85%) receiving dental care in a hospital or medical clinic setting; only 14% had seen a dental professional within the previous 2 years. The majority of participants did not have dental insurance (78%). Clinical examination revealed tooth decay on 30% of mandibular and maxillary molars; 65% had some form of gingivitis. In multivariate analysis, not having dental education and access to a regular dentist were the strongest predictors of not visiting a dentist within the last year.

**Conclusion:** Our results suggest that access to oral health care is limited in Lesotho. Dental decay on molars was prevalent. Further patient oral health education and regular dental care may make an impact on this population.

## Background:

Oral health is central to general health and wellbeing.<sup>[1]</sup> This becomes particularly important when dealing with adolescents, as oral diseases can have a significant psychosocial impact and restrict daily activities, including hours lost from school and work.<sup>[2]</sup> Oral health in the most under-privileged nations is often neglected due to various psychosocial problems such as limited resources, poverty, and lack of access to dental services.<sup>[3]</sup> The countries of Southern Africa, including South Africa, Namibia, Botswana, Lesotho and Eswatini, are home to 63.4 million people. Of this population, 19.1 million are children under the age of 15.<sup>[4]</sup> The Kingdom of Lesotho is within South Africa, and has a population of 2.2 million people. Children under the age of 15 compose 35.7% of the Lesotho population.<sup>[4]</sup>

The United Nations categorized Lesotho as an underdeveloped country with persistently high unemployment rates (23–28%) over the last 10 years.<sup>[5]</sup> In 10 urban centres in Lesotho, nearly a third of the population was receiving food or cash from friends and family outside the Kingdom to provide living

assistance. In the capital Maseru, 46% of the residents receive assistance in the form of food, cash, or both, from outside of Lesotho making it one of the top 20 most unequal countries in the world [6, 7]

Although the government of Lesotho endeavours to provide universal primary health care for all citizens through a decentralized system, facilitating local control and decision-making at the district and community levels, Lesotho has experienced worsening health outcomes over the past decade. The World Bank Group (2018) attributed this trend largely to the burden of HIV/AIDS, comparatively high rates of tuberculosis, and systemic deficiencies.<sup>[7]</sup> Not surprisingly, preventative or therapeutic oral health care is not provided due to the shortage of oral health personnel and challenges in infrastructure.<sup>[8]</sup> A study by Umunna, James & Ricks in 2009, indicated the main barriers to dental care in Lesotho were shortage of staff and general resources compounded by transportation difficulties.<sup>[9]</sup>

According to an epidemiological survey from 1998, 92% of the adult population in Lesotho had dental caries, with 93% of those receiving extractions as treatment.<sup>[10]</sup> Two decades later, a study conducted by Keating et al. (2019) with orphanages in Lesotho only reported on the number referrals to a dental professional;<sup>[11]</sup> the majority of the referrals were due to caries, with dental extraction being the most common form of treatment provided. <sup>[11]</sup> To the best of our knowledge, there is no data regarding the oral health status of the adolescent population in Lesotho. Hence, there was a need to identify psychosocial factors that impact the access to dental care and unmet dental treatment needs in adolescents in Lesotho,<sup>[9]</sup> as elaborated in the framework of health service utilization proposed by Andersen and Newman (A&N).<sup>[12]</sup> This framework categorizes the psychosocial factors into three broad categories of predisposing, enabling and need factors. *Predisposing factors* include sex, the availability of a medical doctor, access to health education, having a medical condition, and water fluoridation. *Enabling factors* include financial affordability and means to afford dental care, including annual income, access to transportation, dental insurance, and social support. *Need factors* include clinical needs such as Decayed, Missing or Filled Teeth (DMFT) index for a given population, and subjective needs including oral hygiene, self-reported oral health, and oral health education. Using this framework helps to understand the propensity of a population to access available dental services to meet their unmet dental treatment needs.<sup>[13, 31, 32, 33]</sup> By utilizing the A&N framework of dental service utilization, this study aimed at 1) identifying the unmet dental treatment needs and patterns of dental service utilization by adolescents in the Kingdom of Lesotho, Southern Africa, and 2) characterizing the best predictors for perceived oral health status and dental visits for these adolescents.

## Methods:

This study was made possible via a collaboration between Smile Lesotho Foundation (SLF), academics from the University of British Columbia (UBC) and the National University of Lesotho (NUL) in response to Smile Lesotho Foundation's call to identify the unmet dental treatment need of local adolescents. A collaboration was established with Faculty of Health Sciences, Nursing Department, NUL and SLF to develop a project that would identify these unmet dental treatment needs of adolescents in Lesotho.

Faculty members and students, along with a community dentist from Maseru, educational specialists, Minister of Health and local stakeholders were actively engaged in the development and execution of this project. This project was designed to serve as the foundational step in developing a program to provide long-term primary oral care to the adolescent population in that country.

## Participant Recruitment And Data Collection

After seeking approvals from the Ministries of Health and Education and Training, participant recruitment was done through convenience sampling in the public schools located in Maseru, the capital city of Lesotho (population 2.14 million). This study utilized a self-reported survey and clinical examinations to collect subjective and objective oral health data according to the A&N model of health service utilization. The self-reported survey was an adaptation from the Canadian Oral Health Measure Survey, and questions from World Health Organization household questionnaire were also included to capture a wide range of predictors associated with the oral health status of study participants.<sup>[34, 35]</sup> This manuscript presents only some aspects of the collected data; we have analyzed 40 items from the self-reported data, and other results will be presented in the upcoming manuscripts. The first 28 items on the survey captured the social demographic information, including the environmental risk factors; parents/guardians responded on behalf of the participants to these questions. The last 12 items on the survey were pertinent to self-reported oral health status, including most commonly experienced dental conditions; adolescents responded to these questions, aided by volunteer nursing students from the NUL. Clinical examinations followed the completion of the survey to capture the DMFT data of the study participants. Consent forms and surveys were translated into Sesotho for guardians. Participants included approximately 50 randomly selected students from each of the 10 schools, with participants ranging from grades A/6 to grade E/12. Printed copies of the consent form outlining the study objectives and permission to participate in the dental examination were sent out to the parents/guardians of the participants. The clinical examinations were conducted in available space, either in a classroom setting, a library or an open playground. These examinations utilized single-use disposable instruments including dental mirrors, tongue depressors, cotton rolls, and Marquis® probes.

Four calibrated dentists conducted the oral examinations. Due to time and logistics constraints, the examining dentists collected DMFT data only from teeth #16, 26, 36 and 46 and recorded presence of plaque on any of these four examined molars. All participants were provided with oral hygiene products.

## Statistical analysis

Descriptive statistics were reported using numbers and percentages and then bivariate analysis was carried out using chi-square tests to identify the independent factors associated with self-reported oral health and dental visits. Univariate and multivariable logistic regression were applied to identify the most important predictors for perceived oral health and dental visits of the study sample. All univariate predictors with  $P < 0.10$  were further assessed in the multivariable model. The objective of this analysis

was to identify the independent variables that could strongly explain a statistically significant variation among the dependent variables in a model that is adjusted for other covariates. Adjusted odds ratio (OR) with 95% confidence interval (CI) was reported and the variables with P-value < 0.05 were considered to be statistically significant. Statistical analysis was performed with SPSS, version 9.4 (SPSS Institute Inc, Cary, NC). Missing data was replaced with the overall mean or median of that variable, although it likely reduced variance in the dataset.

## **Results:**

A total of 526 students participated in the survey and clinical examinations; not all guardians provided answers to all the demographic items. The A&N model of health service utilization served as a theoretical framework to determine the predictors that influence the unmet dental treatment needs and patterns of dental service utilization in adolescent-aged school population in Maseru, Lesotho. The findings of the univariate analyses are presented in Tables 1 and 2, bivariate and multivariate results are presented in Tables 3 to 5.

Table 1  
Descriptive data of the independent study variables (N = 526).

Independent study variables*	N (%)
Sex (N = 519)	
Male	164 (31.5)
Female	355 (68.4)
Age (N = 523)	
12–18	468 (89.5)
19+	55 (10.5)
Dental Insurance (N = 509)	
Yes	31 (6.1)
No	396 (77.8)
Don't know	82 (16)
Availability of doctor (N = 511)	
No	469 (91.8)
Yes	42 (8.2)
Transportation to school (N = 319)	
Family car	1 (0.3)
Public transit	37 (11.5)
Walk	281 (87.5)
Quality of life (N = 518)	
Excellent	87 (16.8)
Very good	116 (22.4)
Good	231 (44.6)
Fair	75 (14.5)
Poor	9 (1.7)
Self-reported general health (N = 519)	
Excellent	70 (13.5)
Very good	120 (23.1)
*Response rate was less than 100% due to the missing responses.	

<b>Independent study variables*</b>	<b>N (%)</b>
Good	229 (44.1)
Fair	83 (16)
Poor	17 (3.3)
Self-reported brushing frequency (N = 506)	
Never	6 (1.2)
Only in the morning	189 (37.4)
Only before going to bed	2 (0.4)
Both times	277 (54.7)
Every time I eat	32 (6.3)
Water Fluoridation (N = 515)	
No	223 (43.3)
Yes	162 (31.5)
Don't know	130 (25.2)
Self-reported last Dental Visit (N = 517)	
Less than a year	60 (11.6)
Between 1–2 years	13 (2.5)
Between 2–3 years	23 (4.4)
Between 3–4 years	13 (2.5)
Between 4–5 years	2 (0.4)
More than 5 years	43 (8.4)
Never	363 (70.2)
Oral health education (N = 518)	
No	413 (79.7)
Yes	105 (20.3)
*Response rate was less than 100% due to the missing responses.	

Table 2  
Descriptive results of oral health status of adolescents in Lesotho  
(N = 526).

<b>Clinical Oral Health Status</b>	<b>N (%)*</b>
DMFT tooth #16 (N = 524)	
Sound	380 (72.5)
Decay	141 (26.9)
Missing	3 (0.6)
Filled	0 (0)
DMFT tooth #26 (N = 519)	
Sound	381 (73.4)
Decay	132 (25.4)
Missing	5 (1.0)
Filled	1 (0.2)
DMFT tooth # 36 (N = 519)	
Sound	330 (63.6)
Decay	179 (34.5)
Missing	8 (1.5)
Filled	2 (0.4)
DMFT tooth # 46 (N = 521)	
Sound	352 (67.6)
Decay	157 (29.8)
Missing	10 (1.9)
Filled	2 (0.4)
Plaque status (N = 524)	
Absent	208 (39.7)
Present	316 (60.3)
Unhappy with appearance of teeth (N = 523)	
No	413 (79.0)

\*Response rate was less than 100% due to missing responses.



<b>Clinical Oral Health Status</b>	<b>N (%)*</b>
Yes	110 (21.0)
<b>Self-reported dental treatment needs</b>	
Toothache (N = 523)	
No	412 (78.8)
Yes	111 (21.2)
Sensitivity to hot/cold (N = 523)	
No	275 (52.6)
Yes	248 (47.4)
Bleeding when brushing (N = 523)	
No	314 (60.0)
Yes	209 (40.0)
Self-perceived oral health (N = 518)	
Excellent	59 (11.4)
Very good	106 (20.5)
Good	197 (38.0)
Fair	106 (20.5)
Poor	50 (9.7)
*Response rate was less than 100% due to missing responses.	

Table 3

Frequency distribution of the Andersen and Newman (A&N) predisposing and enabling factors between self-reported oral health and dental visit.

Predisposing factors	Self-reported OH			Dental service utilization		
	Fair/poor N = 156	Excellent/very good/good N = 362	P- value	Visit within the last year N = 153	Visit more than a year ago N = 363	P- value
<b>Age</b>			<b>&lt; 0.001</b>			<b>&lt; 0.001</b>
12–18	129 (28)	334 (72)		125 (27)	337 (73)	
19+	27 (50)	27 (50)		28 (52)	26 (48)	
<b>Gender</b>						
Male	53 (33)	109 (67)	0.4	61 (37)	102 (63)	<b>0.01</b>
Female	102 (29)	250 (71)		92 (26)	258 (74)	
<b>Oral health education</b>						
No	129 (32)	281 (69)	0.3	104 (25)	306 (75)	<b>&lt; 0.001</b>
Yes	27 (26)	78 (74)		49 (48)	53 (52)	
<b>Enabling Factors</b>						
<b>Annual income</b>						
< 1,000 LSL	55 (78)	175 (71)	0.3	24 (75)	210 (73)	0.7
> 1,000 LSL	16 (23)	70 (29)		8 (25)	79 (27)	
<b>Availability a regular MD</b>						
No	138 (30)	326 (70)	0.9	122 (26)	341 (74)	<b>&lt; 0.001</b>
Yes	13 (31)	20 (69)		27 (64)	15 (36)	
<b>Availability a regular dentist</b>						
No	152 (30)	350 (70)	0.6	142 (28)	360 (72)	<b>&lt; 0.001</b>
Yes	3 (21)	11 (79)		11 (79)	3 (21)	
<b>Dental insurance</b>						
Yes	11 (36)	20 (65)	0.6	9 (31)	20 (69)	1.0

Predisposing factors	Self-reported OH			Dental service utilization		
	Fair/poor N = 156	Excellent/very good/good N = 362	P- value	Visit within the last year N = 153	Visit more than a year ago N = 363	P- value
No	121 (31)	273 (69)		127 (32)	266 (68)	
<b>Avoiding dental treatment due to cost</b>						
Yes	9 (24)	28 (76)	0.3	21 (58)	15 (42)	< <b>0.001</b>
No	144 (31)	328 (70)		129 (27)	344 (73)	
<b>Having social support</b>						
Yes	1 (1)	200 (82)	<b>0.002</b>	1 (3)	275 (95)	0.6
No	29 (41)	16 (7)		30 (94)	15 (5)	
Below mean	28 (39)	79 (32)		9 (28)	99 (34)	
<b>Dental services</b>						
Nowhere	7 (24)	22 (76)		2 (7)	28 (93)	
Dentist	11 (33)	22 (67)	<b>0.05</b>	21 (64)	12 (36)	< <b>0.001</b>
Nearby clinic	53 (24)	166 (76)		65 (30)	154 (70)	
Hospital	67 (34)	129 (66)		62 (32)	130 (68)	
Community centre/other	2(40)	6 (60)		2 (11)	9 (89)	

Table 4

Frequency distribution of the Andersen and Newman (A&N) need factors between self-reported oral health and dental visit.

Need factors	Self-reported OH		P-value	Dental service utilization		P-value
	Fair/poor N = 156	Excellent/very good/good N = 362		Visit within the last year N = 153	Visit more than a year ago N = 363	
<b>Self-reported need factors</b>						
<b>Toothache</b>						
No	96 (25)	311 (77)	< 0.001	106 (26)	301 (74)	< 0.001
Yes	60 (55)	50 (46)		48 (44)	61 (56)	
<b>Sensitivity to hold or cold</b>						
No	56 (21)	216 (79)	< 0.001	80 (30)	189 (70)	0.1
Yes	100 (47)	145 (59)		74 (30)	173 (70)	
<b>Bleeding gums when brushing</b>						
No	73 (23)	239 (77)	< 0.001	100 (32)	210 (68)	0.2
Yes	83 (41)	122 (60)		54 (26)	152 (74)	
<b>Unhappy with teeth appearance</b>						
No	102 (25)	308 (75)	< 0.001	109 (27)	300 (73)	0.003
Yes	54 (51)	53 (50)		45 (42)	62 (58)	
<b>Self-reported quality of life</b>						
Excellent/Very good/Good	107 (25)	308 (74)	< 0.001	130 (30)	300 (70)	0.6
Fair/Poor	48 (58)	35 (42)		22 (27)	60 (73)	
<b>Importance of oral health</b>						
Extremely important/important	153 (31)	345 (69)	0.8	145 (29)	350 (71)	0.03
Not important	1 (20)	4 (40)		4 (80)	1 (20)	

Need factors	Self-reported OH			Dental service utilization		
	Fair/poor N = 156	Excellent/very good/good N = 362	P- value	Visit within the last year N = 153	Visit more than a year ago N = 363	P- value
<b>Self-reported general Health</b>						
Excellent/very good/Good	304 (73)	112 (27)	<b>&lt; 0.001</b>	326 (70)	138 (30)	<b>0.007</b>
Fair/Poor	57 (59)	40 (41)		29 (69)	13 (31)	
<b>Frequency of tooth brushing</b>						
Morning	17 (24)	87 (37)	<b>0.009</b>	6 (19)	102 (35)	0.099
Morning and night	54 (76)	143 (61)		23 (72)	175 (61)	
After eating	0	15 (6)		3 (9)	23 (8)	
<b>Distance to dental facility</b>						
Mean (SD): 6.86 (12.45)						
Above mean	41 (58)	119 (47)	0.2	20 (63)	143 (50)	0.2
Below mean	30 (42)	126 (51)		12 (38)	146 (51)	
<b>Reason for last dental visit</b>						
Within a year for prevention	5 (7)	21 (9)	0.5	4 (13)	23 (8)	<b>0.05</b>
Emergency/Never	66 (93)	223 (91)		28 (88)	266 (92)	
<b>Clinical need factors</b>						
Tooth # 16						
Sound	97 (26)	278 (74)	<b>0.002</b>	106 (28)	271 (72)	0.3
Decayed	56 (40)	84 (60)		45 (33)	92 (67)	
Tooth #26						
Sound	276 (73)	100 (27)	<b>0.03</b>	93 (25)	284 (75)	<b>0.001</b>
Decayed	82 (63)	49 (37)		52 (40)	77 (60)	

Need factors	Self-reported OH			Dental service utilization		
	Fair/poor N = 156	Excellent/very good/good N = 362	P- value	Visit within the last year N = 153	Visit more than a year ago N = 363	P- value
Tooth # 36						
Sound	246 (76)	79 (24)	<b>0.003</b>	88 (27)	239 (73)	0.4
Decayed	112 (63)	66 (37)		54 (31)	121 (69)	
Tooth #46						
Sound	259 (75)	87 (25)	<b>0.006</b>	93 (27)	256 (73)	0.3
Decayed	98 (62)	59 (38)		48 (31)	106 (69)	
Plaque status						
No	34 (48)	103 (42)	0.4	9 (28)	131 (45)	
Yes	37 (52)	142 (58)		23 (72)	158 (55)	<b>0.05</b>

Table 5

Multivariate logistic regression depicting predictors from Andersen and Newman framework.

A&N factors	Bivariate analysis			*Multivariate analysis			
	Crude OR (95%CI)	P-Value	S.E.	Adjusted OR (95%CI)	P-Value	S.E.	R <sup>2</sup>
<b>Self-perceived oral health</b>							
No health education	2.414 (1.051, 5.541)	<b>0.04</b>	0.424	2.732 (1.144, 6.521)	<b>0.02</b>	0.444	0.177
Yes, oral health education	1						
Poor/fair general health	2.619 (1.368, 5.014)	<b>0.004</b>	0.331	3.233 (1.590, 6.575)	<b>0.001</b>	0.362	
Good/excellent general health	1						
<b>Last dental visit</b>							
No health education	4.381 (2.090, 9.183)	<b>&lt; 0.001</b>	0.378	4.559 (2.052, 10.130)	<b>&lt; 0.001</b>	0.407	0.045
Yes to health education	1			1			
Unavailability of doctor	7.962 (2.780, 22.803)	<b>&lt; 0.001</b>	0.537	7.201 (2.273, 22.811)	<b>0.001</b>	0.588	
Readily available doctor	1			1			
Less frequent brushing	1.302 (0.889, 1.905)	0.2	0.194	1.631 (1.034, 2.575)	<b>0.04</b>	0.233	
Optimum frequency of brushing	1			1			
*Forward conditional method adjusted for other predisposing, enabling and need factors.							

Outcome variables:

The two outcome variables in this study were grouped as

1. 1. *Self-reported oral health*, with (0) indicative of excellent/very good/good and (1) indicative of fair/poor;
2. 2. *Last dental visit*, with (0) less than year ago and (1) one to five years ago/never.

Independent variables:

The independent variables for this study were grouped into three domains: predisposing, enabling and needs based predictors. **Predisposing factors** included: age, sex and access to oral health education. **Enabling factors** included: annual income, availability of a regular dentist and medical doctor, having dental insurance, avoidance of dental treatment due to cost, availability of social support, and availability of dental services were sought. **Need factors** included having clinical dental conditions such as toothaches, temperature sensitivity, bleeding when brushing, plaque status, and decay, as well as satisfaction with the overall appearance of the dentition, self-reported quality of life and general health, the importance of oral health, frequency of tooth brushing, distance to the nearest dental facility, and the reason for the last dental visit.

## Univariate Results

The mean age of the study population was 16.4 (SD = 6.3) years and 68% of the examined adolescents were female. The majority of the participants walked to school (88%), with only one participant travelling to school by car. Most of the participants' parents/guardians (83%) reported that they could not afford dental insurance and that a family dentist was not available in their community (92%). Many of the participants reported that they have good to excellent general health (81%) and good to excellent quality of life (84%). Around 55% of the adolescents brushed their teeth twice per day; 37% brushed their teeth only once, in the morning hours. Only 32% of the participants reported consuming fluoridated water; 25% were not aware of the presence of fluoride in their drinking water. The majority (80%) of participants were not exposed to oral health education in school or at home (Table 1).

Table 2 shows that almost one third (30%) of participants reported their oral health as fair or poor. Oral health examination revealed that many of the adolescents had decay in a lower left molar (35%, tooth #36) followed by a lower right molar (30%, tooth #46). More than half of the study population had visible dental plaque.

## Bivariate Analysis

### Outcome 1: *Self-reported oral health*

All the predisposing, enabling and need factors were investigated to find significant predictors for the two outcome variables. Amongst the predisposing factors, age ( $p < 0.001$ ) was significantly associated with self-reported oral health. Participants within the age range of 12–18 were more likely to report the health of their mouth as excellent/good than the participants 19 years of age or older. The enabling factors associated with self-reported oral health included having social support ( $p = 0.02$ ) and access to a dental office ( $p = 0.05$ ; Table 3). The children of parents/guardians who reported having social support were more likely to rate their oral health as excellent/good. For self-reported need factors, it was observed that having a toothache ( $p < 0.001$ ), tooth sensitivity ( $p < 0.001$ ), and bleeding when brushing ( $p < 0.001$ ) were significantly associated with self-reported oral health. Adolescents with no toothache, tooth sensitivity



and bleeding gum were more likely to rate the health of their mouth as excellent/good than their counterparts. Other need factors related to self-reported oral health include dissatisfaction with appearance of teeth ( $p < 0.001$ ), general health ( $p < 0.001$ ), and brushing frequency ( $p = 0.009$ ). The clinical need factors included decay in teeth #16 ( $p = 0.002$ ), #26 ( $p = 0.03$ ), #36 ( $p = 0.003$ ), and #46 ( $p = 0.006$ ; Table 4).

### Outcome 2: *Last dental visit*

The predisposing factors positively associated with a dental visit within the year included age ( $p < 0.001$ ), sex ( $p = 0.01$ ), and having exposure to oral health education ( $p < 0.001$ ; Table 3). Adolescents with exposure to some form of oral health education were more likely to visit a dental professional with the last year than the adolescents who did not have such exposure. The enabling factors positively associated with having a dental visit within the last year were: availability of a regular medical doctor ( $p < 0.001$ ), availability of a regular dentist ( $p < 0.001$ ), avoiding dental treatment due to cost ( $p < 0.001$ ), and where dental services were sought ( $p < 0.001$ ). Participants who had access to a regular dentist and a regular medical doctor were more likely to visit a dental professional within the last year. The self-reported need factors of having a toothache ( $p < 0.001$ ), dissatisfaction with the teeth appearance ( $p = 0.003$ ), and having excellent/good general health ( $p = 0.007$ ) were positively associated with the last dental visit. Of the clinical need factors, the presence of dental plaque ( $p = 0.05$ ) and increased decay in tooth #26 ( $p = 0.001$ ; Table 4) were associated with a dental visit within the past year.

## Multivariate Analyses

Multivariate logistic regression (forward conditional logistic regression) was adopted to report the adjusted odds ratio and identify the most important predictors from A&N framework for perceived oral health and last dental visit. Missing data pairwise option assisted in excluding subjects from the analyses with missing variables.

### Outcome 1: Self-reported oral health

The A&N factors that best predicted perceived oral health status in adolescents are presented in Table 5. After adjusting for other predisposing, enabling, and need factors, the most important predictors for perceived oral health of adolescents were oral health education and general health. Participants were nearly 3 times more likely to report fair/poor oral health if they had no oral health education, compared to those with oral health education exposure (OR: 2.732; 95%CI: 1.144, 6.521). The odds of reporting fair/poor oral health were 3 times greater in study participants with self-perceived fair/poor general health in comparison to those with good/very good/excellent general health (OR:3.233; 95%CI: 1.590, 6.575).

### Outcome 2: Last dental visit

The A&N factors that best predicted regularity of dental visits among the adolescents are presented in Table 5. After adjusting for other predisposing, enabling, and need factors, it was observed that oral

health education, availability of medical doctor, and increased frequency of brushing were identified as the most important predictors for regularity of dental visits. Adolescents with oral health education were four times (OR:4.559; 95%: 2.052, 10.130) more likely to visit a dentist within the last year in contrast to adolescents with access to no oral health education. Also, availability of medical doctors within the residing area of the participants increased the odds of visiting a dentist within the last year by seven times, compared to those with no access to a regular medical doctor (OR:7.201; 95%CI: 2.273, 22.811).

## Discussion

This is the first study to identify the self-reported oral health status and patterns of dental service utilization within the adolescent population in Lesotho. We utilized the A&N model of health service utilization to identify the strongest predictors of self-reported oral health and dental service utilization as employed in our previous studies. [31, 32, 33]

For predisposing factors, we found that adolescents who reported receiving some oral health education were more likely to have visited a dental professional within the last year, which corroborates the findings from Jessani et al. in 2016, and Jessani et al. in 2019. [32, 31] However, 80% of adolescents had not been exposed to any form of oral health education. This is concerning as adolescents are in a developmental stage during which they establish lifelong habits, attitudes, and beliefs. [15] Their early knowledge and behavioural habits can substantially shape their long-term habits, including improper oral care, [16] such as advocated during pregnancy. [32] Hence, not getting proper oral health education can lead to less than adequate oral care practices, with the consequence of oral infections including dental decay. This was further substantiated in our multivariate analysis that identified a lack of oral health education as a major predictor of both fair/poor self-reported oral health, as well as infrequent dental visits. Henceforth, for capacity building, the volunteer nursing students were trained to provide oral health education session in all the secondary classes at end of each day. These sessions included interactive presentation regarding proper brushing and flossing technique and healthy eating habits including limiting the consumption of sugary beverages.

Our study identified several A&N enabling factors that were significantly associated with the two outcome variables, having social support and reporting excellent/very good/good oral health, which is similar to other studies. It has been shown that having social supports such as transportation, housing, and employment, can lead to better oral health and dental service utilization. [31] This social support can result in a better quality of life that can be positively related to a better perception of oral health, as reported in this study. We also found that avoiding dental treatment due to cost was significantly associated with irregular dental visits, as financial constraints remain the most important barrier preventing access to dental care. [36] Lack of financial affordability and unmet dental treatment needs can lead to poor oral health status. [22] In several low-income countries such as Lesotho, the cost of treating dental caries can cause an extra burden on the healthcare system. Therefore, preventive oral health programs including oral health education may substantially reduce these infections and personal cost associated with the

treatment.<sup>[24]</sup> Having access to a regular medical doctor and a regular dentist were positively related to having had a dental visit within the last year, as was also found by Jessani et al in 2020.<sup>[31]</sup> In fact, our multivariate analysis revealed the lack of availability of medical doctors within their neighbourhood increased the odds of irregular dental visits by seven times. Participants who were unable to access a medical doctor were also less likely to visit a dental professional within the last year. This indicates that barriers to access to health care are widespread across health disciplines. The health care system in Lesotho is faced with the challenge of insufficient health care professionals in the fields of medicine, pharmacy, and dentistry.<sup>[19]</sup> Medical care in Lesotho is provided at all three levels: national, district and local health centers, while oral health is not currently provided at the local level due to shortages of professionals and crumbling infrastructure.<sup>[8]</sup>

Our study also showed positive associations between A&N needs factors such as self-reported quality of life and general health with self-reported oral health, as discussed by others, including Jessani et al 2016 and 2020.<sup>[31, 33]</sup> Adolescents who reported fair/poor oral health were more likely to also report fair/poor general health and quality of life. A study in Yemen found out that people who perceived their general health as very good/excellent were also likely to perceive their oral health as very good/excellent.<sup>[21]</sup> Our results further indicated that adolescents who reported having toothache, bleeding gums, and were unhappy with the appearance of their teeth, were more likely to report their oral health status as fair/poor. Similar results have been reported by David et al in a 2006 study in Kerala, India, where self-reported oral status was found to be related to appearance of teeth and caries experience.<sup>[29]</sup> The reason for this finding might be attributed to a lack of education and preventive oral health services.<sup>[29]</sup>

The clinical need factor associated with self-reported oral health status was having dental decay. Not surprisingly, adolescents were more likely to report their oral health status as fair/poor if they had decayed teeth. Tooth decay is one of the most common infections reported globally, which can affect overall well-being and the quality of life. Our study found that 35% of the adolescents had decay in a lower left molar and 30% had decay in a lower right molar. This is a concern as the average age of our population was 16.4 years, which means their first molars have erupted less than a decade ago. Although these findings are similar to other studies, it is a starkly different from countries such as Finland, where the authors found that at age 15, only 5% of participant first permanent molars were decayed.<sup>[30]</sup> In addition, our results showed that more than half of the study population had plaque deposits, and a very slight number were identified with restored teeth. This indicates that there is a significant proportion of adolescents with unmet oral health needs and improper oral hygiene practices, as found in another study.<sup>[17]</sup> Such findings can negatively affect academic performance, social development and nutritional intake, thus impeding the well-being and development of adolescents.<sup>[18]</sup> Adolescents with no dental plaque and less tooth decay were more likely to report regular dental visits, which yet again confirms the association between access to care and better oral health outcomes.<sup>[27]</sup>

## Conclusion

This is the first assessment of the oral health of adolescents in Lesotho that identified predisposing factors, enabling factors, and needs predictors. We found several psychosocial factors that correlated with the self-reported oral health status and patterns of dental service utilization in our study population. The literature on oral health promotion strategies is heavily in favour of sustainable, culturally appropriate, and community-based initiatives. Results from this study can be utilized by oral health professionals and policy makers to provide long-term prevention-based dental care to adolescent population in the Kingdom of Lesotho.

## **Limitations:**

Our results did not come without limitations. The targeted sampling approach resulted in only a small percentage of students from each school being included in the data collection. The surveys were not completed in full by all parents/guardians, and missing data may have skewed the results. Dental decay was not examined on full dentition, which may have biased the implication of the findings. No radiographic examinations were performed to confirm the extent of dental decay, which likely means that decay was underestimated as radiographs may identify decay that the dentist cannot see on visual inspection. Despite these limitations, this initial study of provides valuable insights into the unmet oral health needs of adolescents in Maseru, Lesotho.

## **Abbreviations**

DMFT

Decayed, Missing, Filled Teeth

A&N

Andersen and Newman

SLF

Smile Lesotho Foundation

BC

British Columbia

NUL

National University of Lesotho

WHO

World Health Organization

MS

Microsoft

SPSS

Statistical Package for the Social Sciences

CI

Confidence Interval

SD

Standard Deviation

OR

Odds Ratio

## **Declarations**

### **Ethics approval and consent to participate**

Ethics approval was sought by University of Saskatchewan Behavioural Ethics Board. Consent was sought by the parents of all the adolescents who participated in this study.

### **Consent for publication**

All the coauthors have provided their consent for the publication.

### **Availability of data and materials**

N/A

### **Competing interests**

Authors declare no competing or conflict of interest.

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### **Authors' contributions**

AJ is the primary author of if this manuscript. His task in this research included writing the research proposal and developing this manuscript (introduction, results, discussion and conclusion). Statistical analysis and interpretation of results were performed by FQ, JL and DL while EN and MB helped in designing and writing the manuscript. Two undergraduate dental students AE and KH also significantly contributed in developing this manuscript. Their tasks mainly included conducting the literature review and have significantly contributed to this manuscript, from presenting ideas to formatting and presentation.

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## References

1. Jin LJ, Lamster IB, Greenspan JS, Pitts NB, Scully C, Warnakulasuriya S. Global burden of oral diseases: emerging concepts, management and interplay with systemic health. *Oral diseases*. 2016 Oct;22(7):609–19.
2. Lisboa CM, de Paula JS, Ambrosano GM, Pereira AC, de Castro Meneghim M, Cortellazzi KL, Vazquez FL, Mialhe FL. Socioeconomic and family influences on dental treatment needs among Brazilian underprivileged schoolchildren participating in a dental health program. *BMC Oral Health*. 2013 Dec;1(1):56. 13(.
3. The World Oral Health Report  
Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century—the approach of the WHO Global Oral Health Programme. *Community Dentistry and oral epidemiology*. 2003 Dec;31:3–24.
4. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. *World population prospects: the 2015 revision*.
5. Damane M, Sekantsi LP. The sources of unemployment in Lesotho. *Modern Economy*. 2018 May 8;9(5):937 – 65.
6. Crush J, Frayne B. The invisible crisis: urban food security in Southern Africa.
7. World Bank. 2019. *Overview*. [online] Available at:  
<<http://www.worldbank.org/en/country/lesotho/overview>> [Accessed 17 April 2020].
8. Government of Lesotho. *National Health Strategic Plan*. 2016.
9. Umunna A, James S, Ricks E. The experiences of dentists in the management planning of oral health services in Lesotho, Africa.
10. Government of Lesotho. *Lesotho Health Policy*. Government of Lesotho; 2011 p. 1–65.
11. Keating EM, Sanders J, Ngo K, Mohapi EQ, Mandalakas AM. Development of a Tool for Health Screening and Assessment in Orphanages in Lesotho. *The American journal of tropical medicine and hygiene*. 2019 May 1;100(5):1290-3.
12. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *The Milbank Quarterly*. 2005 Dec;83(4):Online–only.

13. Baker SR. Applying Andersen's behavioural model to oral health: what are the contextual factors shaping perceived oral health outcomes? *Community Dentistry and Oral Epidemiology*. 2009 Dec;37(6):485–94.
14. Macnab A, Kasangaki A. 'Many voices, one song': a model for an oral health programme as a first step in establishing a health promoting school. *Health promotion international*. 2012 Mar 1;27(1):63–73.
15. World Health Organization. Oral health promotion through Schools. WHO information series on school health. Document 11. Geneva: World Health Organization, in press 2003. Ref: WHO. NMH/NPH/ORH/School/03.3;.
16. Folayan MO, Kolawole KA, Oyedele T, Chukumah NM, Onyejaka N, Agbaje H, Oziegbe EO, Osho OV. Association between knowledge of caries preventive practices, preventive oral health habits of parents and children and caries experience in children resident in sub-urban Nigeria. *BMC oral health*. 2014 Dec 1;14(1):156.
17. Adekoya–Sofowora CA, Nasir WO, Oginni AO, Taiwo M. Dental caries in 12-year-old suburban Nigerian school children. *African Health Sciences*. 2006;6(3):145–50.
18. Seirawan H, Faust S, Mulligan R. The impact of oral health on the academic performance of disadvantaged children. *American journal of public health*. 2012 Sep;102(9):1729–34.
19. Downs S, Montagu D, Da Rita P, Brashers E, Feachem RG. Health system innovation in Lesotho: design and early operations of the Maseru public–private integrated partnership. *Healthcare public-private partnerships series*. no. 1. San Francisco: The Global Health Group. Global Health Sciences, University of California, San Francisco, and PwC.; 2013 Mar.
20. Okeigbemen SA, Nnawuihe UC, Osemwegie C. Dental caries experience and oral health behavior among 7–15 years old children attending military and paramilitary schools in Benin City. *Savannah Journal of Medical Research Practice*. 2015;4(1):15–20.
21. Alhajib MN, Halboub E, Amran AG, Alkheraif AA, Al-Sanabani FA, Al-Makramani BM, Al-Basmi AA, Al-Ghabri FA. Link between perceived oral and general health status among Yemeni adult dental patients. *BMC oral health*. 2019 Dec;19(1):93.
22. Jürgensen N, Petersen PE. Promoting oral health of children through schools–Results from a WHO global survey 2012. *Community Dent Health*. 2013 Dec 1;30(4):204 – 18.
23. Nyamuryekung'e KK, Lahti SM, Tuominen RJ. The relative patient costs and availability of dental services, materials and equipment in public oral care facilities in Tanzania. *BMC oral health*. 2015 Dec;15(1):74.
24. Listl S, Galloway J, Mossey PA, Marcenes W. Global economic impact of dental diseases. *Journal of dental research*. 2015 Oct;94(10):1355–61.
25. Sim SJ. Association between oral health status and perceived general health (EuroQol-5D). *J Dent Hyg Sci*. 2014 Aug;14(3):364–70.
26. Watt RG. Strategies and approaches in oral disease prevention and health promotion. *Bull World Health Organ*. 2005;83:711–8.

27. Greenberg BL, Glick M. Assessing systemic disease risk in a dental setting: a public health perspective. *Dental Clinics*. 2012 Oct 1;56(4):863 – 74.
28. Bourgeois DM, Phantumvanit P, Llodra JC, Horn V, Carlile M, Eiselé JL. Rationale for the prevention of oral diseases in primary health care: an international collaborative study in oral health education. *International dental journal*. 2014 Oct;64:1–1.
29. David J, Åstrøm AN, Wang NJ. Prevalence and correlates of self-reported state of teeth among schoolchildren in Kerala, India. *BMC Oral Health*. 2006 Dec;6(1):10.
30. Vehkalahti MM, Solavaara L, Rytömaa I. An eight-year follow-up of the occlusal surfaces of first permanent molars. *Journal of dental research*. 1991 Jul;70(7):1064–7.
31. Jessani A, Aleksejuniene J, Donnelly L, Craig Phillips J, Nicolau B, Brondani M. Dental care utilization: patterns and predictors in persons living with HIV in British Columbia, Canada. *Journal of public health dentistry*. 2019 Mar;79(2):124–36.
32. Jessani A, Laronde D, Mathu-Muju K, Brondani MA. Self-perceived oral health and use of dental services by pregnant women in surrey, British Columbia. *J Can Dent Assoc*. 2016 Dec 1;82:g28.
33. Jessani A, Aleksejuniene J, Donnelly L, Phillips JC, Nicolau B, Brondani M. What are the self-reported unmet dental treatment needs of people living with HIV in British Columbia? A case of minority subpopulation in Canada. *Journal of Public Health Dentistry*. <https://doi.org/10.1111/jphd.12355>.
34. Household Questionnaire. World Health Survey [Internet]. 2002 [cited 2020May31]; Available from: <https://www.who.int/healthinfo/survey/whslonghouseholdlow.pdf>.
35. Canadian Health Measures Survey. Canadian Health Measures Survey Ottawa: Health Canada; 2011.
36. Brondani M, Wallace B, Donnelly L. Dental insurance and treatment patterns – implications to oral health outcomes. *J Can Dent Assoc*. 2019;85:j10.

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